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WINTER HOME RANGE AND HABITAT USE OF FEMALE NORTHERN SAW-WHET OWLS ON ASSATEAGUE ISLAND, MARYLAND

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ABSTRACT.—We quantified home range size and habitat selection of seven female Northern Saw-whet Owls (*Aegolius acadicus*) on Assateague Island, Maryland, during the winters of 1996 and 1997. Home range size (95% fixed kernel) was 103.5 ha (± 50.3 SE). Home range size increased with time spent radio tracking as biweekly home ranges were smaller than those calculated for longer time periods. Home ranges often overlapped in time and space and in one instance the home range for one owl was completely within that of another owl. Northern Saw-whet Owls used primarily pine woods and shrub swamp habitats, with pine woods used more often than any other habitat type and significantly more than expected based on habitat availability. *Received 7 June 2001, accepted 26 February 2002.*

The east coast of the United States is a migration corridor for Northern Saw-whet Owls (*Aegolius acadicus*); they commonly are captured and banded at coastal migration sites, including Cape May in New Jersey (Duffy and Kerlinger 1992), Assateague Island in Maryland (Brinker et al. 1997), and Cape Charles in Virginia (Whalen et al. 1997). Coastal shrub habitat may be important as stopover sites during migration and as wintering habitat (Loos and Kerlinger 1993). Little is known, however, about wintering habitat and ecology of Northern Saw-whet Owls, particularly from coastal islands. The only published studies from coastal islands involved winter food habits (Holt et al. 1991) and winter roost sites (Churchill et al. 2000).

We radio tagged and monitored Northern Saw-whet Owls at Assateague Island, Maryland, to quantify winter home range and habitat use. Habitat on the island differs in structure and species composition from the mainland, and the island vegetation is unusual compared to breeding habitat in boreal forests (Cannings 1993, Churchill 1998). The main objectives of this study were to determine winter home ranges of Northern Saw-whet Owls, estimate overlap among individual home ranges, and to examine habitat use and selection on Assateague Island.

STUDY AREA AND METHODS

We conducted the study on a 1,621-ha portion of Assateague Island (38° 10′ N, 75° 10′ W) in Worcester County, Maryland. The ocean side of this coastal barrier island is an interdunal grassland (10% of the study area) sparsely vegetated with herbaceous plants and shrubs including beach plum (*Prunus maritimus*), beach grass (*Ammophila breviligulata*), and bayberry (*Myrica cerifera*). Another 9% is intertidal beach and bare sand. The bay side is an extensive tidal marsh (*Spartina alterniflora*, *S. patens*, *Distichlis spicata*; 36%), some of which grades into myrtle shrub swamp (*Myrica pensylvanica*; 36%). Forest habitat on the island is characterized by loblolly pine (*Pinus taeda*; 7%) and oak (*Quercus* spp.; 1%). Open water makes up the remaining 1%. We calculated coverage of habitat types from vegetation maps developed by the National Park Service.

We captured owls at four sites in pine woods using 61-mm mist nets with broadcast of Northern Saw-whet Owl vocalizations as an audiolure (Erdman and Brinker 1997). We did not begin to capture and band until late December or early January to ensure that these owls were not migrants. We determined age by molt (Pyle 1997) and gender by DNA analysis of approximately 20 μl of blood (Fleming et al. 1996) obtained through venipuncture of a wing or leg. All owls were equipped with a 3-g backpack-harnessed transmitter representing approximately 3% of the weight of the bird. After we released the owls, we found and monitored them using a unidirectional antenna. We estimated locations by triangulation from stations with known coordinates derived from global positioning systems data. We obtained ≥3 bearings for each estimate using a hand-held receiver and yagi antenna, and we made ≤1 location/h from sunset to sunrise, following the protocol of White and Garrott (1990). We continued radiotelemetry until the birds left the island or lost their radio harness.

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We calculated home ranges for all owls (seven females) that had ≥30 accurate location estimates; two were "after hatch year" (>20 months old) and the other five were "hatch year" (8–10 months old). We overlaid location estimates on a background map of the island; any occurring outside the boundaries of the island and locations with 95% confidence ellipses with areas >500 ha were eliminated because of limited accuracy. In the final analyses, we used 871 location estimates of the 986 collected. The number of estimated locations used for an individual owl's home range calculation ranged from 36–241 and the number of days tracked ranged from 7–80. Four individuals had >100 estimated locations.

We used the fixed kernel method (Worton 1995, Seaman and Powell 1996) to calculate owl home ranges with optimal smoothing parameters chosen by least squares cross validation (LSCV). Kernel methods use a smoothing parameter "h" to smooth contours around location points. Choice of smoothing parameter by LSCV is recommended because of its objectivity, consistency of estimation, and ability to minimize the difference between true and estimated density of location points (Silverman 1986, Worton 1995, Seaman and Powell 1996). We standardized home ranges across individuals by using smoothing parameters from initial calculations for each individual to determine a median optimal smoothing parameter at 30% and 95% utilization distribution levels. Home ranges then were recalculated with the parameter set to the median value. We also calculated minimum convex polygon (MCP) home ranges for comparison with other studies.

We calculated biweekly home ranges (with smoothing parameters calculated by LSCV) for individuals tracked for >2 weeks to determine if home ranges for individuals with small numbers of location estimates accurately represented a shorter time frame (biweekly versus winter home range). This allowed us to examine whether home range size increased over time and to determine if owls with smaller data sets used areas similarly to owls that spent the winter on the island. The larger data sets were subdivided into time frames of 10–14 days. Only those biweekly data sets that included ≥25 location estimates were included in the analyses.

To calculate home range overlap, we recalculated home ranges to include only data from the time frame in which both owls were present; i.e., overlap was temporal as well as spatial. We calculated percentage overlap as twice the area of intersection divided by the total combined area of both intersecting home ranges (Churchill 1998).

We compared habitat use at owl location points with habitat available on the study area with a χ^2 goodness-of-fit test (Siegel 1956, Neu et al. 1974). To calculate habitat use, we used only those locations with 95% confidence ellipses <1 ha (an elliptical area with 95% probability of including the owl) as a compromise between sample size and accuracy of habitat identification because the probability of correctly identifying habitat increases with location precision. Fifty-four location points representing six of the seven owls used for home range analysis met this criterion. The number of points per owl ranged from 1–21 (mean = 9). Habitat availability was measured from the vegetation map of the island. Geographically contiguous habitats where owls seldom occurred and that represented small percentages of available habitat were grouped together (beach with grassland, and open water with marsh) to reduce the number of categories with <5 expected observations (Neu et al. 1974). We calculated 95% confidence intervals for each of five habitats using Bailey's confidence intervals to determine which habitats contributed significantly to the overall χ^2 statistic (Cherry 1996). Habitat availability that was higher or lower than the confidence interval for habitat use was considered significantly selected or avoided at $\alpha = 0.05$.

RESULTS

The mean 95% fixed kernel home range size was 103.5 ha (±50.3 SE) with a range of 38.5–248.6 ha (n = 7 owls). During 1996, when the wintering owl population was high, mean home range size was 61.4 ha (range = 38.5–82.1 ha, n = 4). During 1997, when the population was very low, mean home range was 159.7 ha (range = 95.9–248.6, n = 3). We were able to calculate 17 biweekly home ranges (n = 5 owls); mean biweekly 95% home range area was 112.9 ha (range = 28.6–325.9). Most of the biweekly home ranges (mean = 112.9 ha, range = 28.6–325.9) were larger than the seasonal home ranges calculated for four owls (38.5–82.1 ha). The smaller samples of these individuals resulted in home ranges that were similar to many of the biweekly home ranges but much smaller than the seasonal home ranges determined for owls with larger sample sizes.

During 1996 only one pair of individuals had overlapping home ranges (65% overlap) and during 1997 three pairs overlapped (Table 1). Representing the most overlap between any two individuals, the entire range of owl 2 was included within the range of owl 3, and the shapes of the contours were very similar.

Habitat at Northern Saw-whet Owl location points differed from habitat availability (χ^2 = 35.9, df = 4, P = 0.001); pine woods were used significantly more than expected, while marsh-open water habitats were used significantly less than expected (Table 2). We found no significant differences between expected and observed use of the other habitats.

TABLE 1. Fixed kernal home ranges of wintering Northern Saw-whet Owls (*Aegolius acadicus*) tracked on Assateague Island, Maryland, showed areas of overlap.

Dates	Owl	Home range (ha)	Overlap ha	Overlap %
13 Jan. to 20 Jan., 1996	7	82.1		
	6	52.2	37.7	65.0
12 Jan. to 2 Mar., 1997	2	95.9		
	3	134.5	91.2	86.0
8 Jan. to 21 Mar., 1997	1	248.6		
	2	95.9	63.4	41.7
12 Jan. to 2 Mar., 1997	1	248.6		
	3	134.5	57.5	38.2

TABLE 2. Habitat use and availability for Northern Saw-whet Owls wintering on Assateague Island, Maryland, 1996–1997. The availability of loblolly pine habitat was less than the lower confidence limit for use of that habitat; thus, loblolly pine was used by owls significantly more than expected. Conversely, owls avoided marsh-open water habitats, as that availability was greater than the upper confidence limit for its use.

Habitat type	Habitat used (%)[a] Estimate	Habitat used (%)[a] Confidence interval[b]	Habitat available (%)[c]
Loblolly pine	52	33–69	7
Deciduous woodland	4	0–15	1
Grassland-beach	0	0–100	19
Marsh-open water	11	2–26	37
Shrub swamp	33	17–51	36

[a] Based on 54 accurate locations of six individual owls.
[b] Bailey's 95% confidence intervals for habitat (after Cherry 1996).
[c] Proportion of each habitat type on the study area based on a vegetation map developed by National Park Service.

DISCUSSION

Only three other studies have reported home range size for Northern Saw-whet Owls. All used the MCP method. Palmer (1986) estimated a breeding season home range of 78 ha based on size of the territory used by singing males. Because he did not use radio telemetry and surveyed "the optimum habitat available," this likely is a conservative estimate. The owls in our study had a somewhat larger mean winter home range than the one owl tracked by Forbes and Warner (1974) in Minnesota. The breeding season range calculated by Cannings (1987) in British Columbia (150.5 ha) was similar in size to the winter MCP range in our study (150.8 ha).

Size of winter home ranges on Assateague Island increased with time as home ranges of individuals tracked for ≥15 days were larger than biweekly home ranges. This suggests that several weeks may be needed to estimate winter home range size accurately. Consequently, we feel that the four home range estimates calculated with ≥100 location points spanning ≥15 days (mean = 137.9 ha ± 78.1 SE, range = 72.6–248.6 ha; Churchill 1998) are most representative of "winter" home ranges.

Locations of daytime roosts indicated that owls often stayed in a small area (single or multiple roosts ≤20 m from one another) for days or weeks before moving to new locations within the home range hundreds of meters away (Churchill 1998). After spending several days in the new area, owls frequently returned to their original locations. Owls returning to areas used previously, instead of exploring new areas, suggests that home range size becomes stable over time (Churchill 1998). In general, individuals that moved among several patches of conifer forest had relatively large home ranges.

The large degree of overlap in the 95% fixed kernel home ranges among individuals was expected since winter territoriality in Northern Saw-whet Owls has not been reported. If owls are opportunistic hunters, then they could be expected to move within areas of suitable habitat in search of prey. Home range overlap in general and especially the overlap and similarity in shape of the home ranges for owls 2 and 3 further suggest that this species is not territorial during winter. Similarity of home ranges also may have resulted from the habitat configuration characteristic of this portion of Assateague Island, particularly the patchy distribution of pine woods. Thirty percent home ranges usually were centered in pine woods and additional patches of pine woods often occurred at the periphery of 95% contours. Our use of median optimum bandwidth in home range calculations also may have contributed to similarity in shapes and sizes of the two 95% contours for owls 2 and 3.

Winter habitats used by Northern Saw-whet Owls are highly variable, although dense coniferous or deciduous vegetation for roosting and perches for foraging must be present (Cannings 1993). On Assateague Island, deciduous forest habitat was rare, and owls inhabited loblolly pine forest or myrtle shrubland most often. Loblolly pine habitat is similar to other habitats used during winter, such as spruce-fir forests (Simpson 1972), pine groves (Swengel and Swengel 1987), pine plantings and tamarack bogs (Mumford and Zusi 1958), and pine plantations (Wilson 1938). Shrubland habitats on Assateague Island may be structurally similar to the more unusual shrub-steppe habitat described as breeding habitat by Marks and Doremus (1988) and Hayward and Garton (1984), or the hawthorne thicket reported as a wintering area by Scott (1938).

Although availability of the pine woods habitat was limited, owls used it more frequently than any other habitat type and more than expected based on availability. Presumably it contained an attractive prey base as these woods were used during nightly radio tracking when owls likely were foraging. The pine habitat also provided cover as owls frequently were located there during the day in well-hidden roosts (Churchill et al. 2000). Myrtle shrubland (the second most commonly used habitat) also was important, although its use was in proportion to availability. For example, 30% contour of owl 4 was centered in shrubland and it used shrubland extensively while spending little time in pine woods. Habitats more open than shrubland generally were avoided altogether.

Our study identified habitats within one coastal barrier island that are used by wintering Northern Saw-whet Owls. The overall importance of barrier islands as wintering habitat is still unclear. During autumn migration, more owls typically are captured at Maryland's inland banding stations than at Assateague Island, regardless of whether captures were high or low during a given year (Brinker et. al. 1997). This suggests that more owls winter in inland areas than on coastal barrier islands. Studies of the differences in quality of inland and coastal habitats would be valuable for determining if the fitness of owls wintering in the two areas differs.

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